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PENSOFT

Amphibia, Anura, Centrolenidae, *Cochranella resplendens* (Lynch & Duellman, 1973): first record from Brazil and updated map of the geographic distribution

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Abstract
Specimens of the glassfrog *Cochranella resplendens* (Lynch & Duellman, 1973) are known from 13 localities from Colombia, Ecuador, and Peru. Herein, we report the first Brazilian record, which extends the known distribution of the species 2,129 km to the east of the nearest record in Santa Rosa de Sucumbíos Río Rumiyacu, Valle del Guamués, Putumayo, Colombia.

Keywords
Amazon basin, glassfrog, range extension, Tropical rainforest.

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Introduction

Centrolenidae, commonly known as glassfrogs, contains 158 species in 12 genera that are endemic to the Neotropics (Guayasamin et al. 2009; Frost 2020). Frogs of this family are nocturnal, arboreal, and associated with vegetation along streams and rivers in tropical rainforest (Guayasamin et al. 2009). Females deposit eggs on leaves, mosses or rocks above streams, where tadpoles drop after hatching to complete their development (Kubicki 2007; Guayasamin et al. 2009).

The genus *Cochranella* Taylor, 1951, with nine recognized species, is distributed in the low and mid-elevation Neotropical forests, from Honduras to Bolivia (Guayasamin et al. 2009; Twomey et al. 2014; Frost 2020). Four species are trans-Andean: *C. euknemos* (Savage & Starrett, 1967), *C. granulosa* (Taylor, 1949); *C. litoralis* (Ruiz-Carranza & Lynch, 1996), and *C. mache* Guayasamin & Bonaccorso, 2004. Another four have cis-Andean distributions: *C. erminea* Torres-Gastello, Suárez-Segovia & Cisneros-Heredia, 2007, *C. guayasamini* Twomey, Delia & Castroviejo-Fisher, 2014, *C. nola* Harvey, 1996, *C. phryxa* Aguayo-Vedia & Harvey, 2006. *Conchranella resplendens* (Lynch & Duellman, 1973) is on both sides of the Eastern Cordillera.

Cochranella resplendens was described from Santa Cecilia, Provincia Sucumbios, Ecuador, and can be found in lowland and premontane tropical primary and secondary rainforests (Molina-Zuluaga et al. 2017). This species belongs to *C. granulosa* group (Guayasamin et al

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2009). Rojas-Padilla et al. (2019) provided a new locality (Alpahuayo-Mishana, Loreto, Peru) and summarized the known localities of this species, including a dot map. Herein, we provide the first record of *C. resplendens* in Brazil, extending its known distribution more than 2,400 km to the east of its nearest record.

Methods

During 17–21 June 2019 and 27–31 July 2019 we conducted diurnal and nocturnal visual encounter surveys (sensu Crump and Scott Jr 1974) on the eastern Amazon of northern Brazil, in the municipality of Serra do Navio, Amapá state. The collected specimen (under license #48102-2 of the Chico Mendes Institute for Biodiversity Conservation) was fixed in 10 % formalin and preserved in 70 % alcohol following Heyer et al. (1994). This voucher is now deposited at the herpetological collection of the Laboratório de Herpetologia da Universidade Federal do Amapá (CECC). The species were identified morphologically, based on the original description by Lynch and Duellman (1973) and compared with other species of the *Cochranella granulosa* group.

We have obtained Fourteen known locality records for *C. resplendens* from Lynch and Duellman (1973), Cisneros-Heredia and McDiarmid (2005), Terán-Valdez et al. (2009), Malambo et al. (2013), Twomey et al. (2014), Chávez and Mueses-Cisneros (2016), Molina-Zuluaga et al. (2017), Restrepo et al. (2017), and Rojas-Padilha et al. (2019). Additionally, we also obtained more two distribution records at speciesLink database (speciesLink, 2019), totaling 16 records. All coordinates use the WGS84 datum (Fig. 1; Table 1).

Results

***Conchranella resplendens* (Lynch & Duellman, 1973)**
Figures 1, 2

New records. BRAZIL • one adult ♂, snout-vent length (SVL) 24.4 mm; Amapá state, municipality of Serra do Navio, Colônia de Água Branca do Amapari; 0.9410°N,

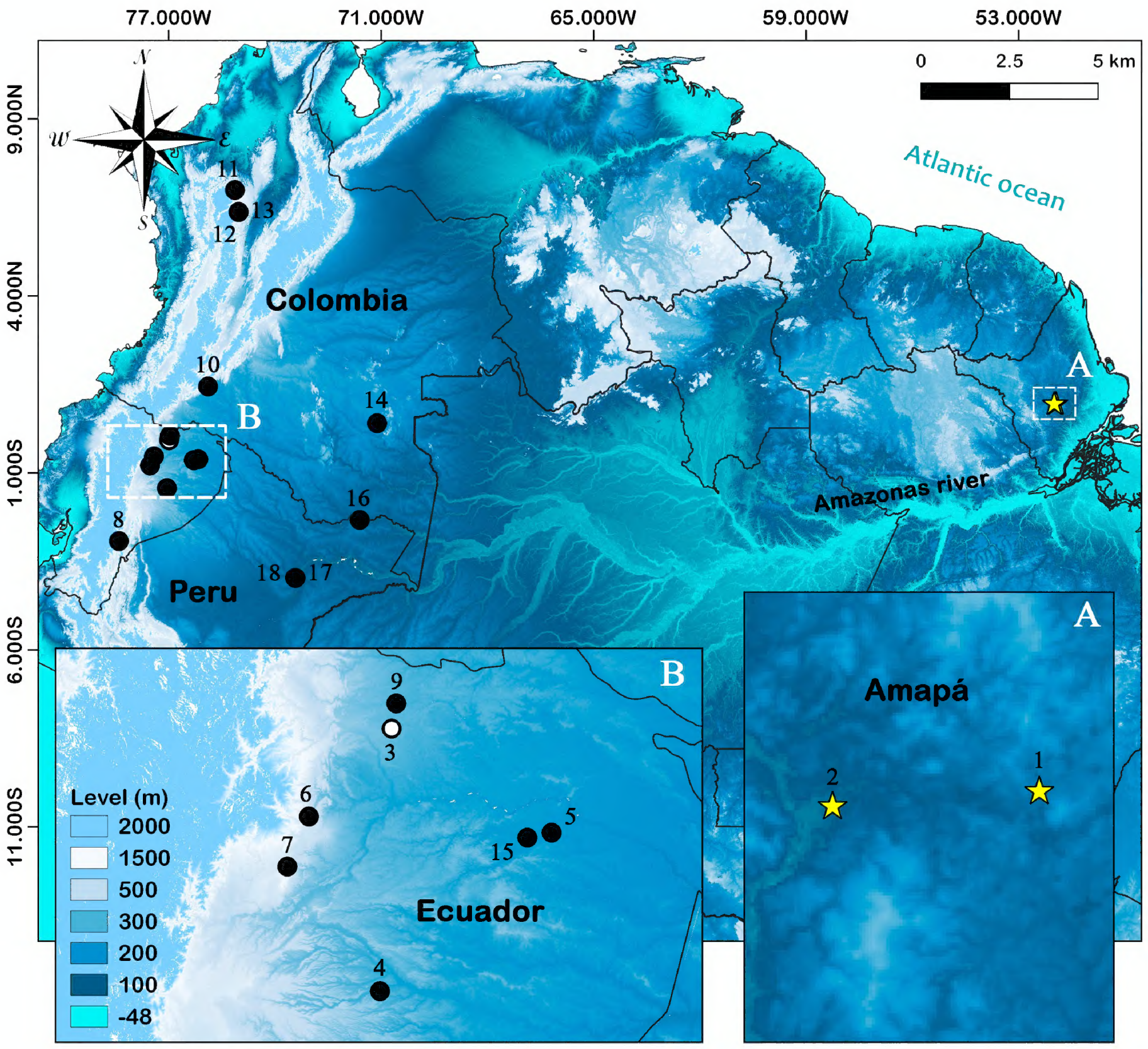

Figure 1. Geographical distribution map of *Cochranella resplendens* (see details in Table 1). Black dots: previously known records localities. White dots: type locality in Santa Cecilia, Sucumbios Province, Ecuador. Stars: new localities reported for Amapá, Brazil.

Table 1. Geographic coordinates from literature and speciesLink records for the occurrence of *Cochranella resplendens*.

Number	Locality	Country	Latitude	Longitude	Source
1	Rural settlements, municipality of Serra do Navio, Amapá state	Brazil	00.9447°	−051.9436°	This study
2	Colônia de Água Branca do Amapari, municipality of Serra do Navio, Amapá state	Brazil	00.9410°	−051.9945°	This study
3	Santa Cecilia, Sucumbios Province	Ecuador	−00.080°	−076.990°	Lynch and Duellman 1973
4	Pozo Garza, Oryx, Pastaza Province	Ecuador	−01.433°	−077.05°	Cisneros-Heredia and McDiarmid 2005
5	Tiputini Biological Station, Orellana Province	Ecuador	−00.616°	−076.166°	Cisneros-Heredia and McDiarmid 2005
6	Viejo de Sumaco, Orellana Province	Ecuador	−00.533°	−077.416°	Cisneros-Heredia and McDiarmid 2005
7	Tiputini Biological Station, Orellana Province	Ecuador	−00.791°	−077.527°	Cisneros-Heredia and Meza-Ramos 2007
8	Napinaza River, Morona Santiago Province	Ecuador	−02.926°	−078.406°	Terán-Valdez et al. 2009
9	Santa Cecilia Río Aguarico Sucumbíos	Ecuador	00.050°	−076.966°	speciesLink 2019
10	Microcuenca La Resaca, municipality of Belén de Los Andaquíes, Caquetá departament	Colombia	01.439°	−075.890°	Malambo et al. 2013
11	Finca El Chaquiral, vereda El Retiro, municipality de Anorí, Antioquia region	Colombia	06.988°	−075.130°	Molina-Zuluaga et al. 2017
12	El Eden, vereda San Antonio, municipality de Alejandría, Antioquia region	Colombia	06.367°	−075.027°	Molina-Zuluaga et al. 2017
13	Cordillera Central in Antioquia department	Colombia	06.367°	−075.027°	Restrepo et al. 2017
14	Santa Rosa de Sucumbíos Río Rumiyacu, Valle del Guamués, Putumayo	Colombia	00.400°	−071.116°	speciesLink 2019
15	Stream near the village of San Jose in the Cainarachi valley near Tarapoto, San Martín region	Peru	−00.642°	−076.291°	Twomey et al. 2014
16	Quebrada Bufeo, Putumayo Province, Loreto region	Peru	−02.330°	−071.607°	Chávez and Mueses-Cisneros 2016
17	José Álvarez Alonso Biological Station, Allpahuayo-Mishana National Reserve, Loreto	Peru	−03.966°	−073.418°	Rojas-Padilha et al. 2019
18	José Álvarez Alonso Biological Station, Allpahuayo-Mishana National Reserve, Loreto	Peru	−03.965°	−073.431°	Rojas-Padilha et al. 2019

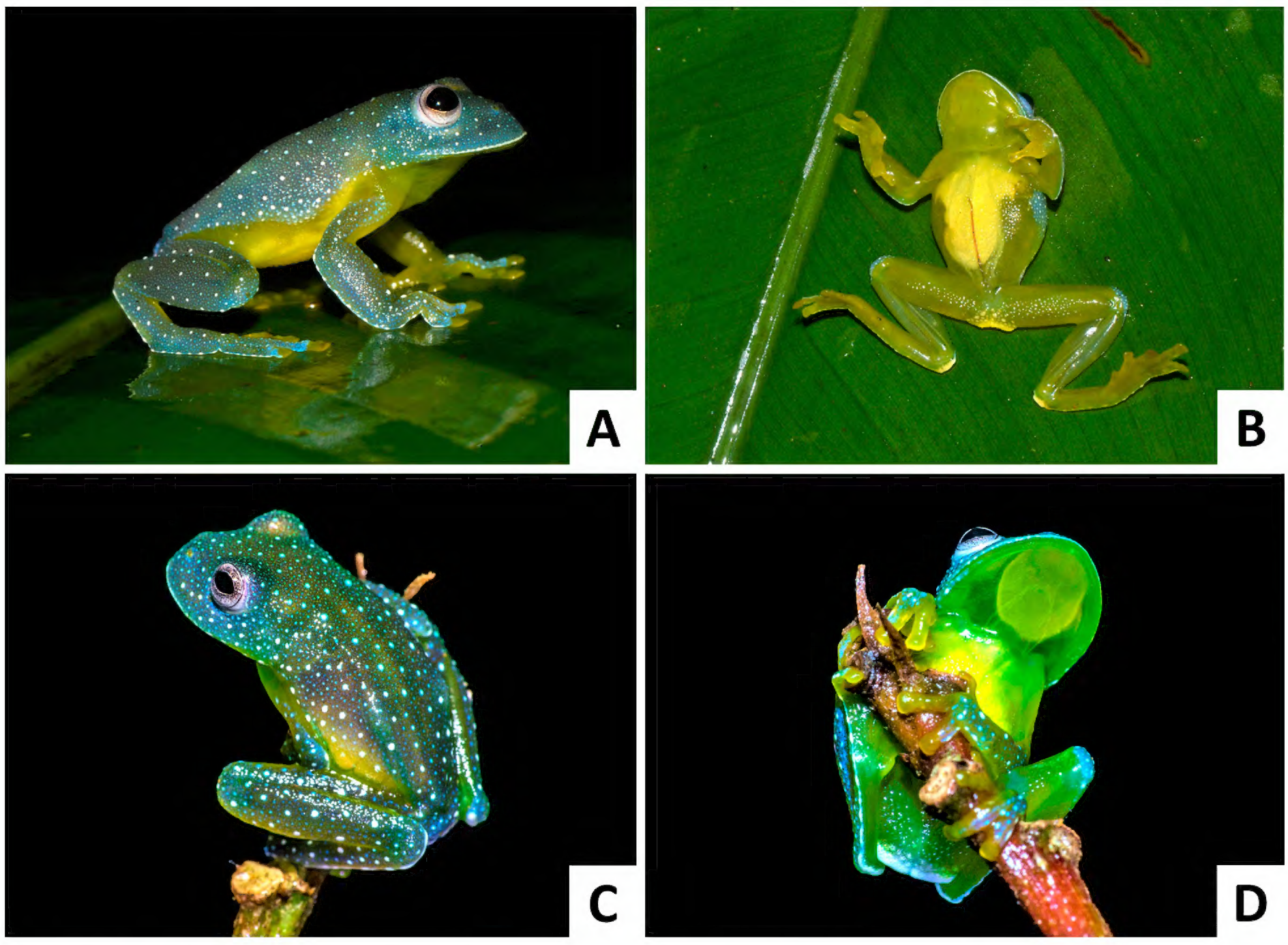

Figure 2. Adult males of *Cochranella resplendens*. **A, B.** Voucher specimen CECC 3361 (SVL = 24.4 mm) from Amapá state, municipality of Serra do Navio, rural settlements of Serra do Navio, Brazil. **C**, **D.** Unvouchered individual photographed in Amapá state, municipality of Serra do Navio, Colônia de Água Branca do Amapari.

051.9945°W; 140 m a.s.l.; 20 Jun. 2019; Rodrigo T. Pinheiro leg.; found at day (17:17 h) perched on a leaf, 50 cm above the ground, on *terra-firme* forest next to a 6 m wide stream (Fig 2A, B); CECC 3361. • one adult, *undetermined sex*; Amapá state, municipality of Serra do Navio, rural settlements; 0.9447°N, 051.9436°W; 130 m a.s.l.; 31 Jul. 2019; Wirley A. Santos leg.; found at night (01:14 h), perched on a leaf, 30 cm above the ground; photographed specimen (Fig. 2C, D); not collected.

Identification. Our specimens exhibit the diagnostic

characteristics described by Lynch and Duellman (1973): white parietal and visceral peritonea; color in life green to dark green with white to bluish-green flecks; round snout in dorsal view and gradually inclined anteroventrally in lateral view; extensive webbing between outer fingers III-IV; dorsal skin shagreened with elevated warts corresponding to flecks; crenulated dermal fold on the outer edge of hands, forearms, and elbows, on heels, tarsi, and feet; pigmented nuptial excrescence; concealed prepollex; humeral spines in adult males absent; cloacal ornamentation composed of enameled tubercules, folds, and crenulated flaps.

The only species of glassfrogs with inclined snout in lateral view and without humeral spines are *C. euknemos* (Savage & Starrett, 1967), *C. mache* (Guayasamin & Bonaccorso, 2004), and *C. phryxa* (Aguayo-Vedia & Harvey, 2006). However, *C. resplendens* is distinguished by having well crenulated folds on hands, ulnae, tarsi and feet (less crenulated fold in *C. euknemos*), color in life green to dark green with white to bluish-green flecks (green or bluish-green dorsum with yellow flecks in *C. euknemos* and *C. mache*), venter yellow (white in *C. granulosa*), well defined and visible tympanum (not visible externally in *C. granulosa* and C. *phryxa* and), and lacking a large dull yellow-colored patch on the top of the head (present in *C. mache*).

Discussion

Although described in the early 1970s (Lynch and Duellman 1973), it was only in 2005 that new records of *Cochranella resplendens* appeared in the literature (Cisneros-Heredia and McDiarmid 2005). Since then, 13 more localities have been added and, what for many decades was considered a microendemic species of the lowland Amazon forest of Ecuador, it is now a widespread species in northern South America from 130–1,700 m a.s.l. The most surprising record was the discovery of specimens in the Central Cordillera of Colombia (Molina-Zuluaga et al. 2017), because they represented the first case of an Amazonian lowland species of glassfrog occurring across the Andes in altitudes varying from about 1,300 to 1,700 m a.s.l. Our new records are also exceptional, in as much as they extend the know distribution of the species 2,129 km to the east from its nearest locality in Santa Rosa de Sucumbíos Río Rumiyacu, Valle del Guamués, Putumayo, Colombia, and 2,784 km to the east from the type locality in Santa Cecilia, Sucumbios Province, Ecuador (Lynch and Duellman 1973). Considering that the two localities are connected by extensive areas of potentially suitable habitat for this species (i.e., primary *terra-firme* forest), we speculate that the absence of records reflects a sampling bias caused by the low detectability of *C. resplendens* rather than a biogeographic pattern. In our experience, this is a canopy species that usually calls from at least 4 m above the water and is rarely encountered even by experienced collectors.

In fact, few known specimens of *C. resplendens* were found near the ground (Lynch and Duellman 1973; Molina-Zuluaga et al. 2017; Rojas-Padilla et al. 2019; this work), because this local is very unusual for glassfrog and may reflect that they fell from higher perches on trees. The two new records presented here, featuring a new and distant population of *C. resplendens* put into question the validity of *C. phryxa*, a very morphologically similar species, suggesting the need for a detailed taxonomic revision (Molina-Zuluaga et al. 2017). A potential problem is that when describing *C. phryxa*, Aguayo-Vedia and Harvey (2006) had not directly studied the type series of *C. resplendens* and purportedly relied on the original description of *C. resplendens* and on Duellman (1978), which were descriptions based of one adult and one juvenile from a single locality.

Thus, it is very likely that the differences reported by Aguayo-Vedia and Harvey (2006) between the two species represent intraspecific variation. In fact, Rojas-Padilla et al. (2019) reported on variation in coloration for this species and provided a photo of an unvouchered adult specimen with a non-evident tympanum, which is one of the two diagnostic characteristics provided by Aguayo-Vedia and Harvey (2006). Since the number of *C. resplendes* specimens available in collections increased considerably and the new information regarding their distribution raised doubts about the validity of the taxon *C. phryxa*, we strongly recommend here a detailed new comparison between these two taxa and a robust review of the validity of the last species.

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Authors' Contributions

All authors wrote, revised, finalized, and approved the manuscript.

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